

REMARKS

35 U.S.C. §103(a) Rejections

Claims 2-18, 20-22, 24, 25 and 38-43 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over multiple references. However, in light of the Supreme Court decision in *KSR v. Teleflex*, any obviousness determination must be consistent with the traditional *Graham* factors. Thus, obviousness is determined according to (1) the scope and content of the prior art, (2) the level of ordinary skill in the art, (3) the differences between the prior art and the claimed invention, and (4) the extent of any objective indicia of nonobviousness.

In this case, the office action fails to provide an objective obviousness analysis based on factual inquiries in accordance with *KSR* and *Graham*. “In determining the differences between the prior art and the claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious.” (MPEP 2141.02). As stated in *KSR*, the mere fact that references can be combined or modified does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art.

Additionally, the key to supporting any rejection under 35 U.S.C. § 103 is the clear articulation of the reason why the claimed invention would have been obvious. The analysis supporting a rejection under 35 U.S.C. § 103 should be made explicit. MPEP § 2143. Rejections on obviousness cannot be sustained with mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. MPEP § 2142. Furthermore, the examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness.

Shimozu, Khandkar, Hatano, and Du References

The office action rejects claims 2, 5, 9, 10, 13, 14, 38, and 43 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Patent No. 02-075167 (the “Shimozu reference”) in view of U.S. Patent No. 5,712,055 to Khandkar *et al.* (the “Khandkar reference”). Claims 18, 20-22, 24, and 25 have been rejected as being unpatentable over the Shimozu and Khandkar references in further view of U.S. Patent Pub. No. 2002/0177026 to Hatano *et al.* (the “Hatano reference”) and U.S. Patent Pub. No. 2004/0258972 to Du *et al.* (the “Du reference”).

In the present case, the office action asserts that it would have been obvious to “select an electrolyte material for the fuel cells of Shimozu that would optimize output of the fuel cell system without compromising fuel utilization, such as taught by Khandkar *et al.*” To reject a claim based on this rationale, Office personnel must resolve the *Graham* factual inquiries. Then, Office personnel must articulate the following:

- (1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference;
- (2) a finding that one of ordinary skill in the art could have combined the elements as claimed by known methods, and that in combination, each element merely performs the same function as it does separately;
- (3) a finding that one of ordinary skill in the art would have recognized that the results of the combination were predictable; and
- (4) whatever additional findings based on the *Graham* factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.

MPEP § 2143(A). The rationale to support a conclusion that the claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination yielded nothing more than predictable results to one of ordinary skill in the art. *KSR v. Teleflex*, 550 U.S. 398, 417, 82 USPQ2d 1385, 1395 (2007); *Sakraida v. AG Pro, Inc.*, 425 U.S. 273, 282, 189 USPQ 449, 453 (1976); *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 62-63, 163

USPQ 673, 675 (1969); *Great Atlantic & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U.S. 147, 152, 87 USPQ 303, 306 (1950). “[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.” *KSR*, 550 U.S. at 418, 82 USPQ2d at 1396. If any of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art. MPEP § 2143(A).

Shimozu, Khandkar, and Cochran References

Claims 3, 4, 6-8, 11, 12, 15-17, and 39-42 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over the Shimozu and Khandkar references in further view of U.S. Patent Pub. No. 2004/0072054 to Cochran *et al.* (the “Cochran reference”). The office action asserts that it would have been obvious for one having ordinary skill in the art at the time of the invention to substitute “one or all of the known electrolyte materials” disclosed by the Cochran reference into the fuel cell disclosed by the Shimozu and Khandkar references to predictably arrived at the applicants’ claims. To reject a claim based on this rationale, the office action must resolve the *Graham* factual inquiries. Then, the office action must articulate the following:

- (1) a finding that the prior art contained a device (method, product, etc.) which differed from the claimed device by the substitution of some components (step, element, etc.) with other components;
- (2) a finding that the substituted components and their functions were known in the art;
- (3) a finding that one of ordinary skill in the art could have substituted one known element for another, and the results of the substitution would have been predictable; and
- (4) whatever additional findings based on the *Graham* factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.

MPEP § 2143(B).

The rationale to support a conclusion that the claim would have been obvious is that the substitution of one known element for another yields predictable results to one of

ordinary skill in the art. If any of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art.

In the present case, the office action fails to fulfill several of these criteria with respect to the two rationales offered in support of the rejections of the claims. Therefore, the applicants respectfully traverse each of the rejections made to claims 2-18, 20-22, 24, 25 and 38-43 under 35 U.S.C. § 103(a) and because the rejections cannot be sustained, the applicants submit that the rejections should be withdrawn.

The cited references fail to disclose the claimed elements and limitations

The prior art references when modified still must teach or suggest all the claim limitations of the rejected claim. The 35 U.S.C. § 103 obviousness rejections of these claims are thus inappropriate because one does not arrive at the present invention as recited in the claims by modifying the Shimozu reference with any of the additionally cited references.

The office action acknowledges that the Shimozu reference “fails to teach that the electrolyte layer of at least one of the fuel cells has a different combination and different operating temperature than another electrolyte layer in the stack.” Although, the office action also admits that the Khandkar reference does not “teach concentric cells as in Shimozu,” the office contends that the Khandkar reference’s disclosure of using multiple types of electrolyte teaches what is claimed when combined with the Shimozu reference. The applicants respectfully traverse this assertion.

Independent claim 2, as amended, explicitly requires that “the electrolyte layer of at least one of the inner and middle fuel cells has a different composition and a higher optimal operating temperature range than the electrolyte layer of the outer fuel cell.” Likewise, dependent claim 38, which is based upon independent claim 2, includes the further requirement that:

[T]he electrolyte layer of the inner fuel cell has a different composition and a higher optimal operating temperature range than the electrolyte layer

of the middle fuel cell, and the electrolyte layer of the middle fuel cell has a different composition and a higher optimal operating temperature range than the electrolyte layer of the outer fuel cell.

Similarly, independent claims 5 and 18, as amended, require that “the electrolyte layer of the first inner fuel cell has a different composition and a higher optimal operating temperature range than the electrolyte layer of the first outer fuel cell.” Dependent claim 9 further requires that “the electrolyte layer of the second inner fuel cell has a different composition and a higher optimal operating temperature range than the electrolyte layer of first outer fuel cell” and dependent claim 13 further requires “the electrolyte layer of the second outer fuel cell has a different composition and a lower optimal operating temperature range than the electrolyte layer of the first inner fuel cell.”

The claimed combination of limitations is not found in the Shimozu reference either alone or in combination with Khandkar reference. The Khandkar reference is silent as to an optimal operating temperature of any electrolyte and is instead focused on selecting an electrolyte based upon its conductivity in a given amount of spent fuel gas. Specifically, the Khandkar reference discloses that as fuel gas passes through each successive stage it becomes more and more depleted and therefore a higher conductive electrolyte is required to draw energy from the system. (*See* col. 5, lines 13-30 of the Khandkar reference). The Khandkar reference merely notes that some electrolytes such as ZrO_2 have higher operating temperatures than a higher conductive electrolyte such as Bi_2O_3 and therefore because “gas flow cools the elements” as it proceeds through the series of fuel cells an electrolyte such as Bi_2O_3 may be used due to the lower temperatures. *Id.* at lines 31-39. However, the Khandkar reference also teaches that electrolytes may be doped to increase their conductivity so that they may be used in a fuel cell stage where another electrolyte could also be used. *Id.* at lines 46-57. Therefore, the Khandkar reference not only teaches the importance of selecting an electrolyte based on conductivity rather than an optimal operating temperature as claimed but also that conductivity of a given electrolyte may be changed allowing it to be used in more than one stage.

Accordingly, the applicants submit that since none of the cited references disclose each and every limitation as claimed, the rejections of the claims 2, 5, 9, 13, 18, and 38 under 35 U.S.C. § 103 are improper and should be withdrawn. Inasmuch as dependent claims 3, 4, 6-8, 10-12, 14-17, 20, 21, 24, 25, and 39-42 depend from and include all the limitations of independent claims 2, 5, and 18, the applicants also submit that the rejection of the dependent claims under 35 U.S.C. § 103 cannot be supported and should be withdrawn.

The office action fails to provide a showing that one of ordinary skill in the art would have recognized that the results of the combination were predictable

The office action fails to provide a valid motivation or suggestion based on the cited references that would lead one skilled in the art to arrive at the claimed invention. To support a finding of obviousness, the cited references must expressly or impliedly suggest the claimed invention or the examiner must provide a convincing line of reasoning as to why the claimed invention would have been obvious to one skilled in the art. Reliance upon the knowledge of the person of ordinary skill in the art is not sufficient without that knowledge being instantly and unquestionably demonstrable as being well-known. MPEP § 2144.03(A). Reliance on such “common knowledge” without greater support is specifically prohibited:

A statement that modifications of the prior art to meet the claimed invention would have been “well within the ordinary skill of the art at the time the claimed invention was made” because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references.

Ex Parte Levengood, 28 USPQ2d 1300 (Bd. Pat. App & Inter. 1993). “There must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR v. Teleflex*, 550 U.S. 398, 418 (2007). Further, “a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *Id.* It is important for the office action “to identify a reason that would have prompted a person of ordinary skill

in the relevant field to combine the elements in the way the claimed new invention does.”
Id.

Additionally, if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. MPEP § 2143.01(VI). Furthermore, “[i]f proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.” MPEP § 2143.01(V) (citing *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)).

In the present case, the cited references fail to provide any express or implied suggestion that their respective teachings could be combined. Despite the lack of an express or implied suggestion to combine the references, the office action fails to provide the necessary “articulated reasoning with some rational underpinning” why one of ordinary skill in the art would be motivated combine the unitary cells disclosed in the Shimozu reference with the serial flow system from the Khandkar reference to predictably arrive at a nested tubular solid oxide fuel cells comprising varying composition of electrolyte layers selected from the group “consisting of Y_2O_3 -doped ZrO_2 , Sc_2O_3 -doped ZrO_2 , and doped- CeO_2 ” as claimed. The only reasoning provided by the office action is the conclusory statement that one having ordinary skill in the art would want to “optimize output of the fuel cell without compromising fuel utilization” and would therefore select the electrolyte material based on temperature.

The applicants respectfully submit that this assertion ignores the teachings of the references which are directed at solving different problems by vastly different methods. For example, the Shimozu reference explicitly displays a fuel stack that provides a common fuel in parallel to the two inner most fuel cells of the stack and a common fuel channel 6d that provides fuel in parallel to the two outer most fuel cells of the stack. (See Figs. 2 and 6 of the Shimozu reference). Conversely, the Khandkar reference teaches a system that is directed at selecting a lower resistance electrolyte material for multiple fuel

cell stack stages arranged in a series in a manner to account for depletion of the fuel concentration at each successive stage in the stack. The Khandkar reference states that:

Fuel gases initially flowing through the electrolyte elements in first stage 10 partially deplete the fuel gas. The partially spent fuel from first stage 10 is no longer practicably useable for high efficiency operation in similar electrolyte elements but can be used by second stage 20 having electrolyte elements composed of the lower resistance CeO_2 electrolyte material. Likewise, the further spent fuel gas discharged from second stack 20 is no longer practicably useable by electrolytes having similar resistance but can be efficiently used by third stack 30 having electrolyte elements constructed from the still lower resistance BiO_3 electrolyte material.

(See col. 5, lines 18-30 of the Khandkar reference). Clearly, the Khandkar reference is describing a series flow system and the Shimozu reference discloses a system with parallel flow.

The applicants respectfully submit that one of ordinary skill in the art would recognize that the teachings of the two references cannot be combined in the manner suggested by the office action without drastically altering the principle of operation of the Shimozu reference, which under the guidelines of MPEP § 2143.01(VI) could not then support a finding of obviousness. For example, electrolyte materials for fuel cells having parallel fuel flow, as taught by the Shimozu reference, must necessarily have fuel concentrations that would be identical between such fuel cells. Therefore, the teachings of the Khandkar reference which explicitly take into account the amount that a fuel gas has been depleted between each successive stage is completely inapplicable to the Shimozu reference. More specifically, the Khandkar reference only teaches selecting more than one type of electrolyte to account for depleted fuel gasses which requires a higher conductive electrolyte to maintain "high efficiency operation." Consequently, the assertion that a "skilled artisan" would be motivated to modify the Shimozu reference with the teachings of the Khandkar reference to "optimize output of the fuel cell without compromising fuel utilization" ignores the fact that the fuel of the Shimozu reference is not depleted within a given inner or outer fuel cell and therefore there is no need to consider "compromising fuel utilization" as suggested by the office action.

Therefore, because the office action does not “identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does” with the requisite “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness,” the office action has failed to establish a *prima facie* case of obviousness. Accordingly, the rejections of the claims cannot be supported and should be withdrawn.

Regarding claims 3, 4, 6-8, 11, 12, 15-17, and 39-42, the office action contends that one of ordinary skill in the art could have substituted the known electrolyte materials from the Cochran reference for an electrolyte used in the Shimozu reference and “the results of the substitution would have been predictable.” The office action then cites to MPEP § 2144.07 as support for the assertion that “it has been held that the selection of a known material based on its suitability for its intended use is obvious.” The applicants respectfully submit that mere knowledge of the listed electrolyte compositions disclosed in the Cochran reference would not lead one of ordinary skill in the art to the present claims with the requisite predictability.

Independent claims 2, 5, and 18 explicitly require the use of more than one electrolyte within the fuel cell stack, wherein at least one of the electrolytes comprises a different electrolyte composition than another electrolyte layer and has a higher optimal operating temperature range than another electrolyte layer in the stack. Merely selecting one of the electrolytes disclosed by the Cochran reference for use in the Shimozu reference does not meet what is claimed. As stated above, the assertion that the combination of the Shimozu and Khandkar references “teach that electrolyte material correlates to operating temperature” is an oversimplification of the teachings of the two references. As a result, the office action has not identified how one of ordinary skill in the art would view the Shimozu, Khandar, and Cochran references in combination and predictably be motivated to use more than one electrolyte in a tubular solid oxide fuel cell in the manner claimed. Since each and every claimed limitation is not found in the prior art, it is unclear how the cited references would lead one of ordinary skill in the art to use more than one type of electrolyte in a single fuel cell stack having “concentric inner and

outer electrode layers” when the concept of doing so is only found in the applicants’ specification and claims.

Therefore, for the reasons stated above, the rejections of claims 2, 5-10, 13, 14, 18, 20-22, 24, and 25 are improper and should be withdrawn.

The office action fails to demonstrate mere substitution between prior art devices

The office action asserts that it would have been obvious to simply substitute one or more of the electrolytes disclosed in the Cochran reference into the teachings of the Shimozu and Khandkar references because the results of the substitution would have been predictable. However, to support such an assertion, the office action must show that the prior art device differs from the claimed device merely by the substitution of one component for another. MPEP § 2143(B). The 35 U.S.C. § 103 obviousness rejections of claims 3, 4, 6-8, 11, 12, 15-17, and 39-42 are thus inappropriate because one does not arrive at the present invention as recited in the claims by simply substituting the electrolytes of the Cochran reference into system of the Shimozu reference, either alone or in combination with the Khandkar reference. For example, independent claims 2 and 18 explicitly require that “the electrolyte layer of the first inner fuel cell has a different composition and a higher optimal operating temperature range than the electrolyte layer of the first outer fuel cell.”

As admitted in the office action, the Shimozu reference merely discloses a fuel cell stack with tubular solid oxide fuel cells and “fails to teach the electrolyte layer of at least one of the fuel cells has a different composition...than another electrolyte layer in the stack.” The Khandkar reference by contrast discloses selecting a different electrolyte for a given stage based upon how much a fuel gas has been depleted. The applicants further submit that the Cochran reference merely discloses the use of an electrolyte paste made from any of several base electrolyte powders. None of the references disclose or even suggest the use of more than one type of electrolyte in a fuel cell stack or the presence of multiple electrolyte layers within a single fuel cell stack as claimed.

The fact that the Cochran reference discusses the use of various types of materials to form an electrolyte paste and the Khandkar reference discloses using multiple types of electrolytes in a series flow fuel stack does not equate to a mere substitution of components as suggested by the office action. Aside from a single reference to a preferred operating temperature of the fuel cell, the Cochran reference is completely silent regarding matching the thermal properties of an electrolyte to its relative position within a fuel cell stack.

Since the cited references fail to disclose each and every limitation of independent claims 2, 5, and 13, the combination of prior art devices differs from the claims by more than a mere substitution of one component for another. Therefore, the rejections of claims are improper and should be withdrawn. Inasmuch as claims 3, 4, 6-8, 11, 12, 15-17, and 39-42 depend from and include all the limitations of independent claims 2, 5, and 13, the applicants submit that the rejections are improper and should also be withdrawn.

The office action relies on hindsight to support the rejections

The applicants submit that, in view of the shortcomings of the cited references, the conclusions of the office action can only be reached through the impermissible use of hindsight. The claimed invention is not simply a “predictable use of prior art elements according to their established functions,” and the office action provides no objective reason to combine their respective teachings to arrive at the claimed invention. “A factfinder should be aware ... of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.” *KSR*, 550 U.S. at 421.

In re McLaughlin states that hindsight reasoning is proper if it is only taking into account “knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant’s disclosure.” 443 F.2d 1392 (CCPA 1971). In the present case, it is not understood how one of ordinary skill in the art would be motivated to use multiple different types of electrolytes in a single fuel cell stack when the concept of doing so is wholly absent from

the prior art. The applicants respectfully submit that the only way to support the present rejections is by using the knowledge found only in the applicants' specification.

The applicants further submit that the present rejections are exactly the type of distortion that the court in *KSR* warned of. This is clearly inappropriate, as "the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure." MPEP § 2143. Here, the office action has failed to demonstrate that the prior art discloses the use of more than one type of electrolyte. Because the office action cannot support the rejection without relying on the applicants' disclosure, the rejections are improper and should be withdrawn.


Therefore, the applicants respectfully submit that the Shimozu, Khandkar, Cochran, Hatano, and Du references do not render the claimed invention obvious because they do not disclose all of the limitations of the independent claims and the references provide no motivation to modify the system of the Shimozu reference with the teachings of the additionally cited references to arrive at the claimed invention. The applicants, therefore, respectfully traverse the rejections and request that the rejections of claims 2-18, 20-22, 24, 25, and 38-42 under 35 U.S.C. § 103 be withdrawn.

CONCLUSION

Please consider the amendments and remarks. The applicants acknowledge and thank the examiner for the notice of allowable subject matter in the office action; however, in view of the present amendments and comments, the applicants respectfully submit that all of the present claims are distinguished from the prior art and are in condition for allowance. Please contact the undersigned attorney at the address and telephone number noted below with any questions or comments.

Respectfully Submitted,

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